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Larner et al.

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(54) **METHOD FOR PLACING AN INTERMEDIATE DEVICE IN SERIES WITH AT LEAST ONE WIRE**

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(51) **Int. Cl.**

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H01R 43/01	(2006.01)
H01R 4/24	(2006.01)
H01R 9/03	(2006.01)
H01R 11/20	(2006.01)
H01R 43/16	(2006.01)
H01R 43/28	(2006.01)

(52) **U.S. Cl.**
CPC ***H01R 43/01*** (2013.01); ***H01R 4/24*** (2013.01); *H01R 9/031* (2013.01); *H01R 11/20* (2013.01); *H01R 43/16* (2013.01); *H01R 43/28* (2013.01)

(58) **Field of Classification Search**
CPC H01R 4/24; H01R 9/031; H01R 11/20; H01R 43/01; H01R 43/16; H01R 43/28; Y10T 29/49002; Y10T 29/4913; Y10T 29/49162; Y10T 29/49169; Y10T 29/49181; Y10T 29/49195; Y10T 29/49222
USPC 29/592.1, 835, 850, 854, 861, 869, 874; 439/391–410
See application file for complete search history.

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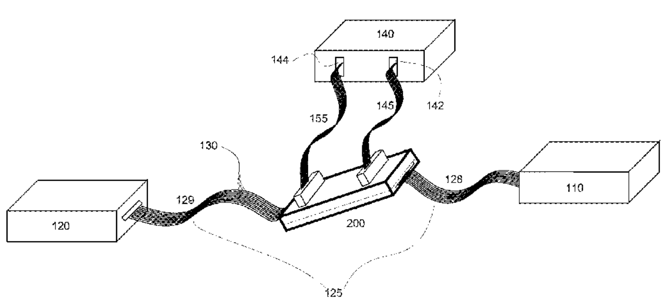
(74) *Attorney, Agent, or Firm* — Lerner, David, Littenberg & Krumholz & Mentlik, LLP

(57) **ABSTRACT**

Aspects of the disclosure relate generally to a connector including a housing with a severing device and a pair of wire taps built into the housing. For example, the severing device may sever the electrical connection along one or more wires placed inside the connector. The pair of wire taps may patch into the severed ends of the wires, intercepting any signal transmitted through the wires, and patching any signal transmitted along the wire tap into the severed wires. The wire taps may further be connected to an intermediate device, placing the intermediate device in series with the ends of the severed wire. The connector may also include a switching device between the first and second wire taps. When the switching device is closed, the switching device may directly connect the wire taps, shorting out the intermediate device and effectively reestablishing the direct electrical connection between the severed wire ends.

4 Claims, 8 Drawing Sheets



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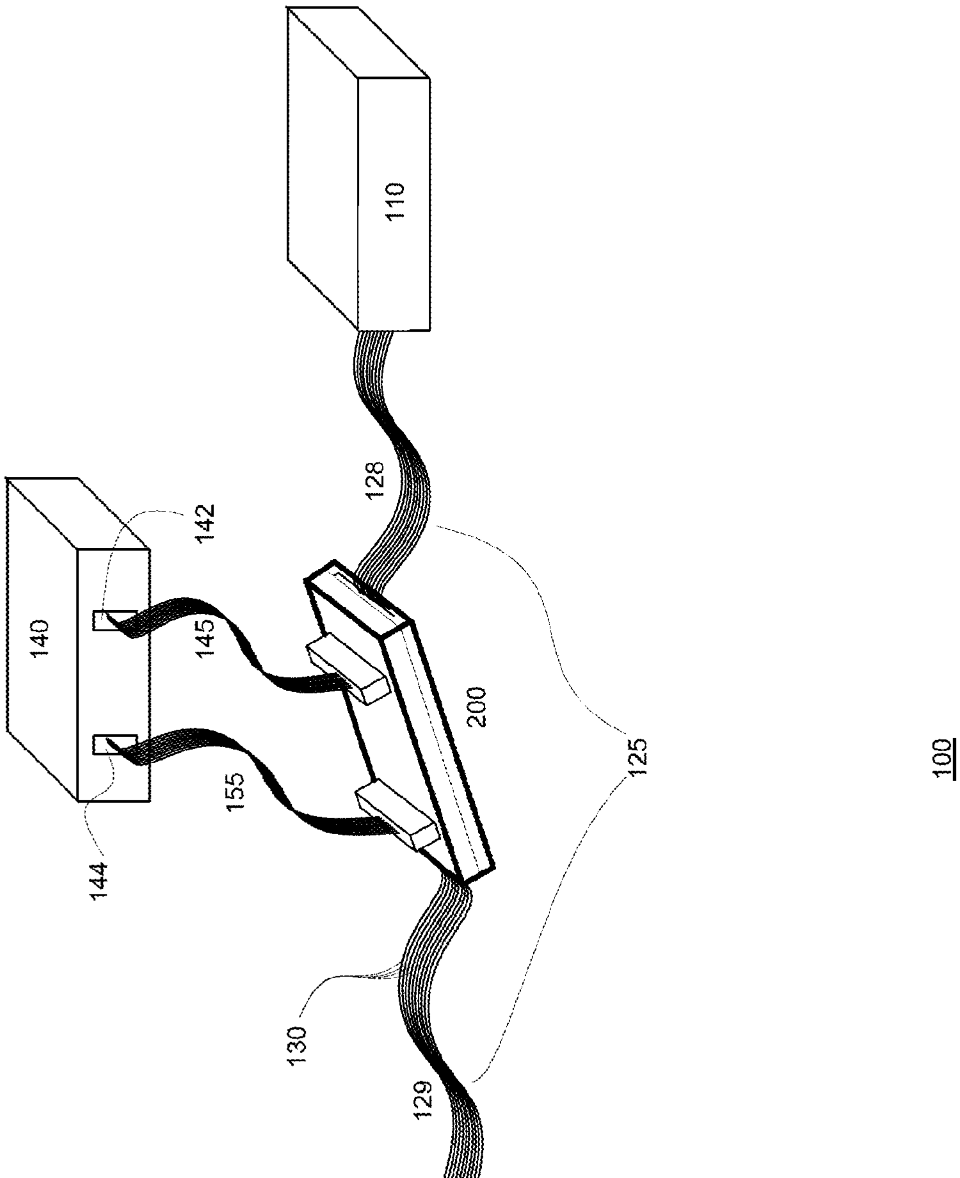


FIGURE 1

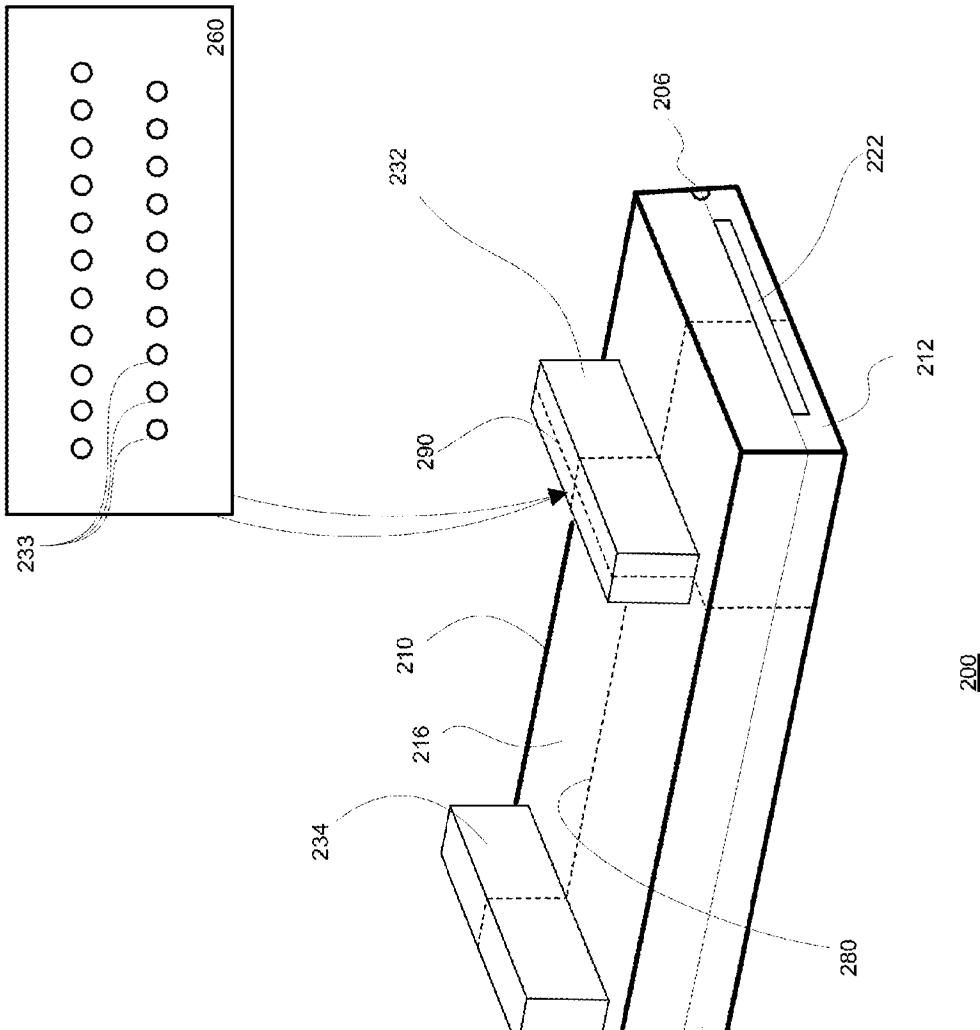
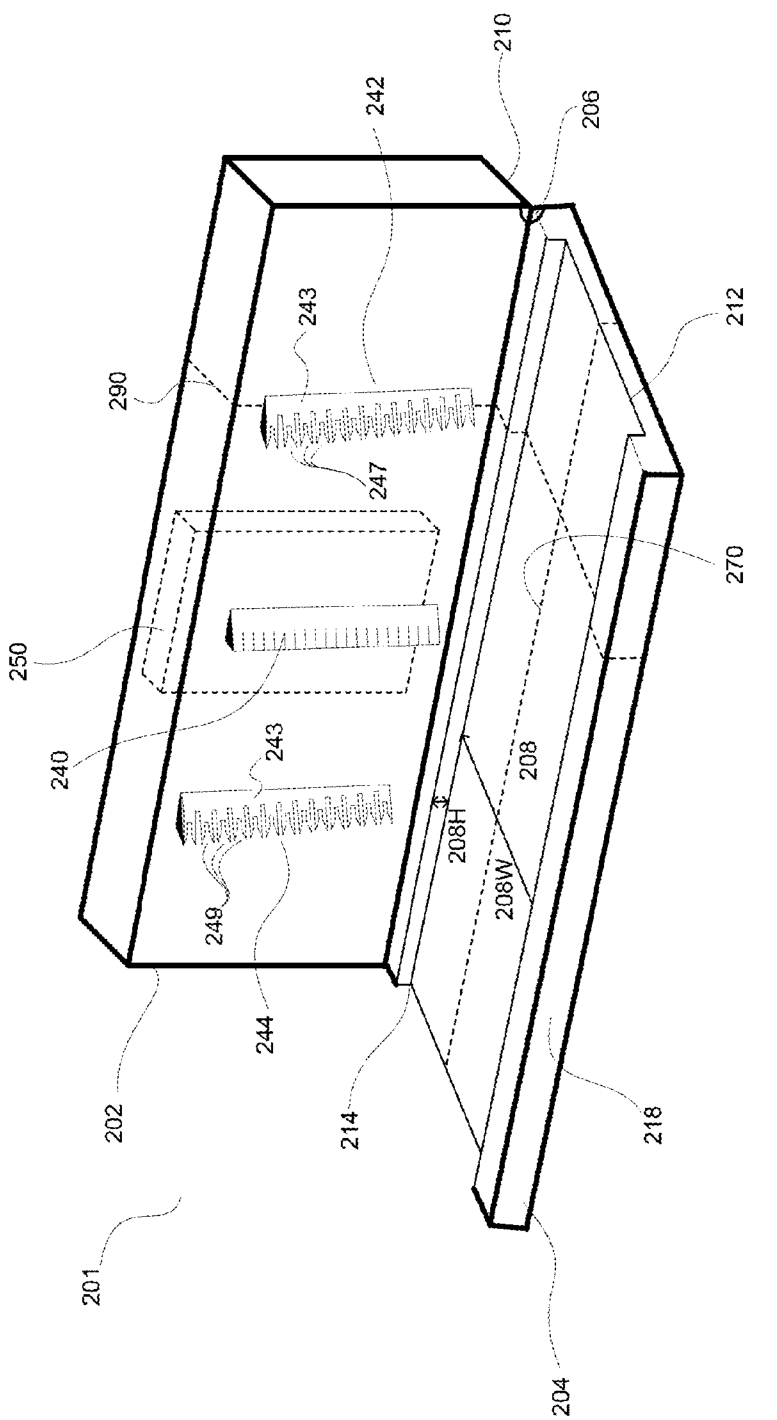

260
233
232
290
206
222
212
210
216
234
280
200
201
218
224
202
203
214
204

FIGURE 2


210
206
242
243
212
290
247
270
250
240
243
208
208H
208W
249
244
202
214
218
201
204

200

FIGURE 3

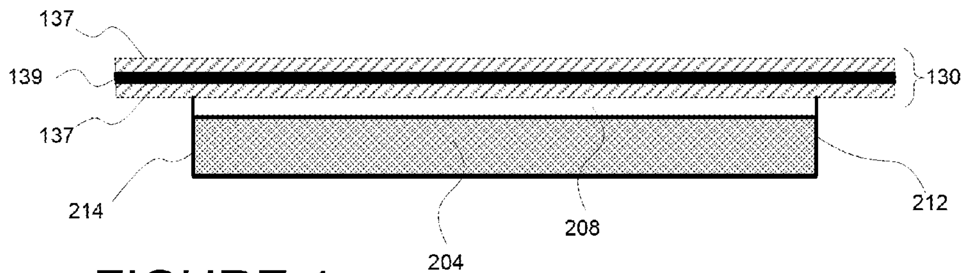


FIGURE 4

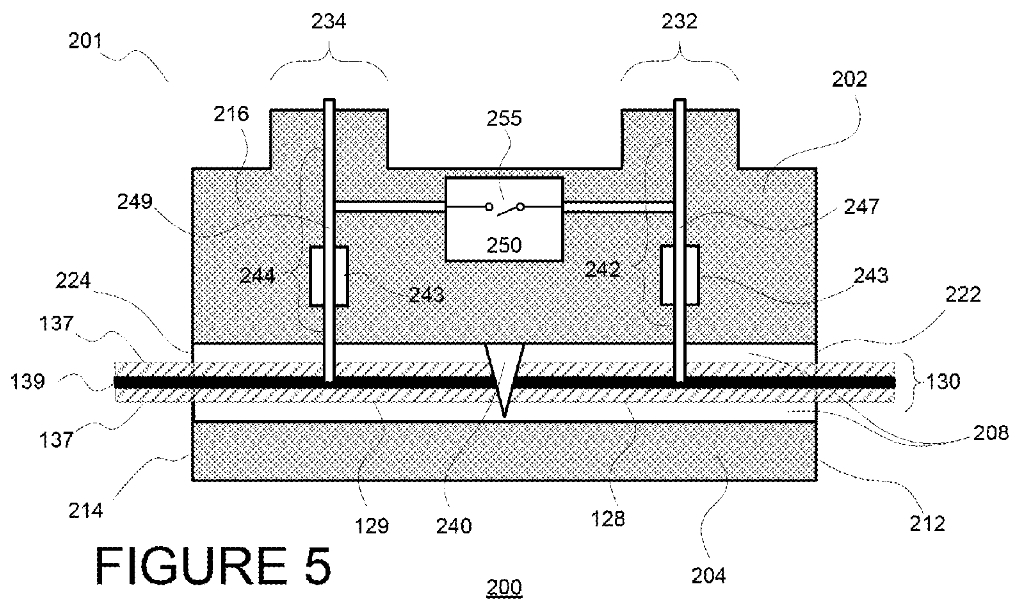
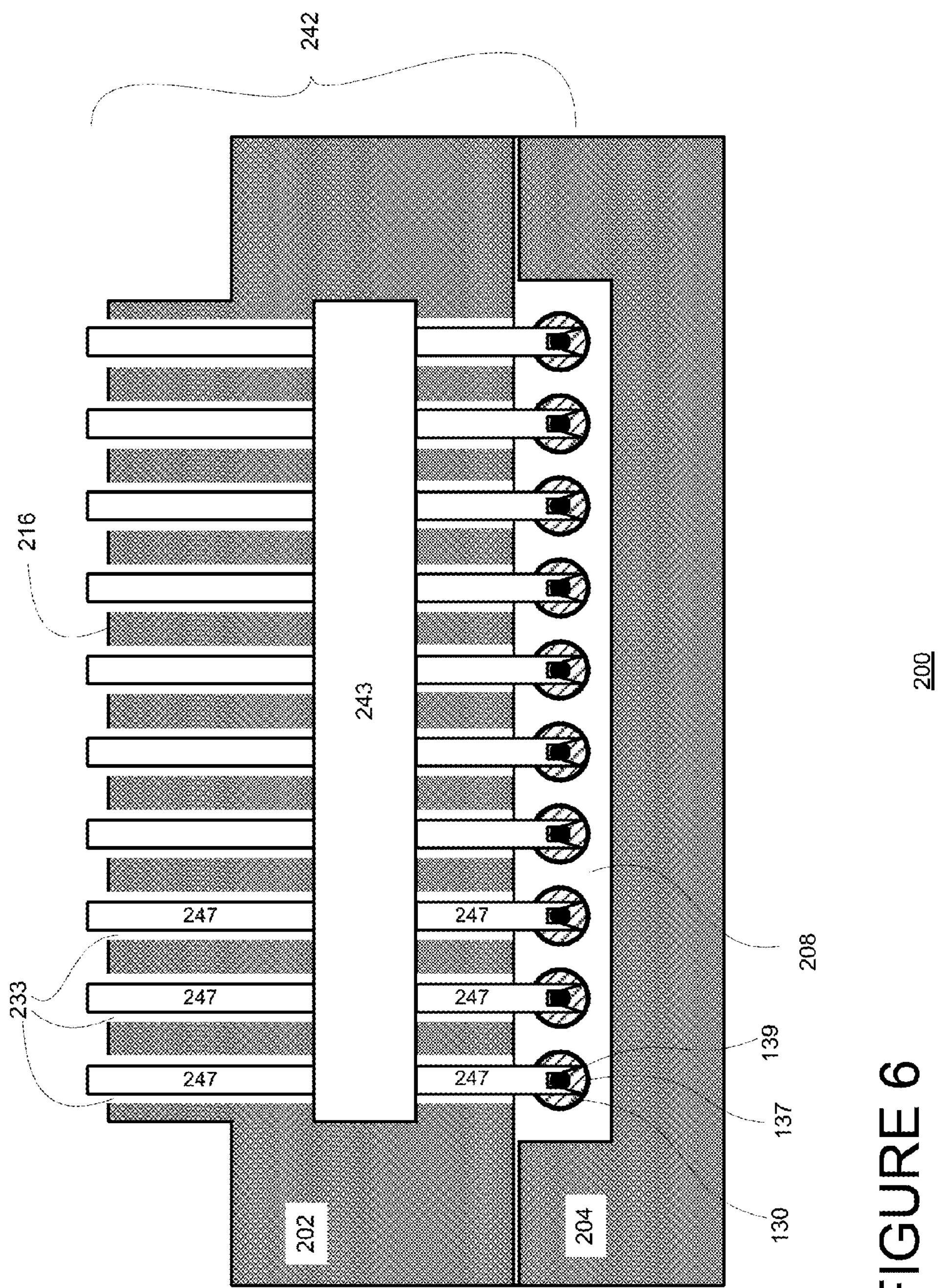
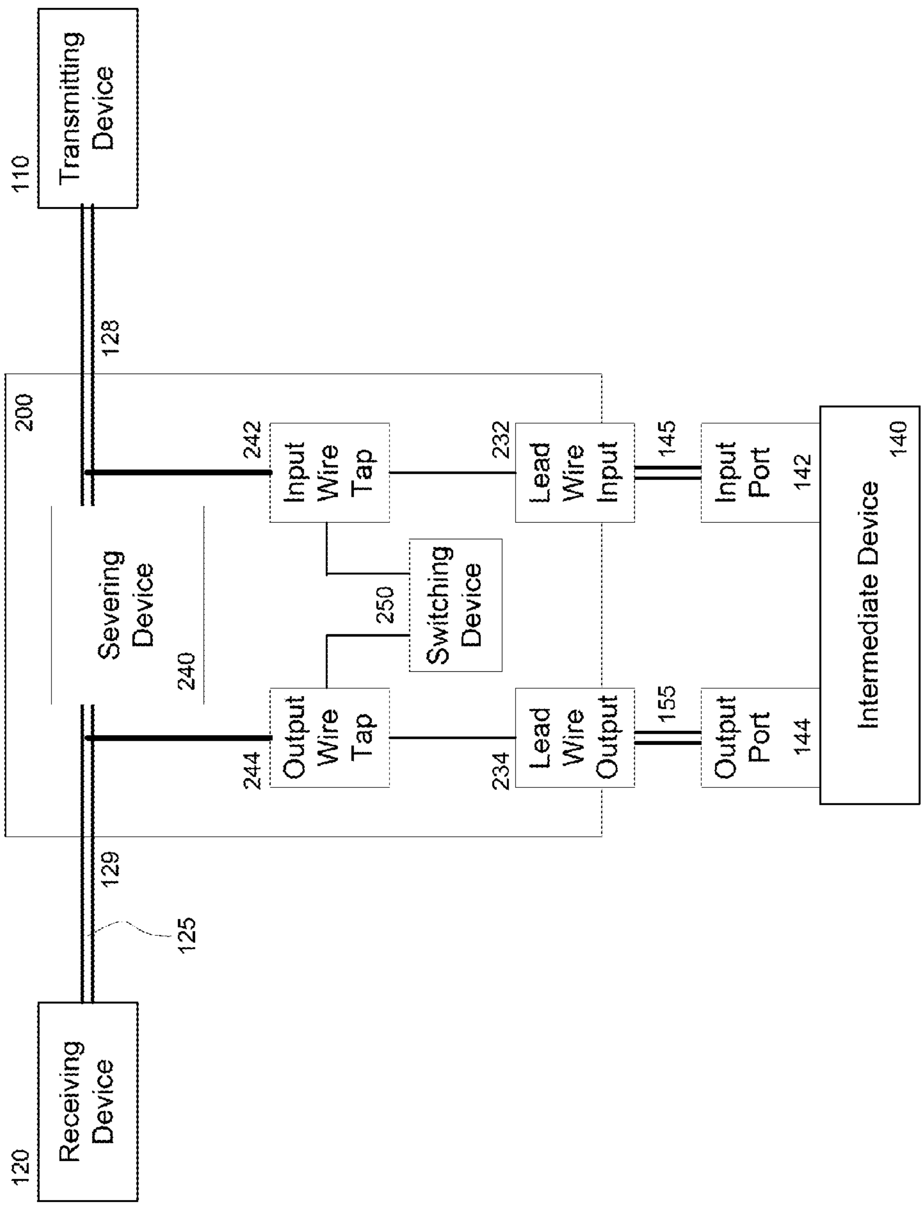


FIGURE 5



242
216
243
247
247
247
247
247
247
233
208
139
137
130
202
204
200

FIGURE 6


110
Transmitting Device
128
200
Severing Device
240
242
Input Wire Tap
232
Lead Wire Input
145
Input Port
142
Switching Device
250
244
Output Wire Tap
234
Lead Wire Output
155
Output Port
144
Intermediate Device
140
129
125
120
Receiving Device

100

FIGURE 7

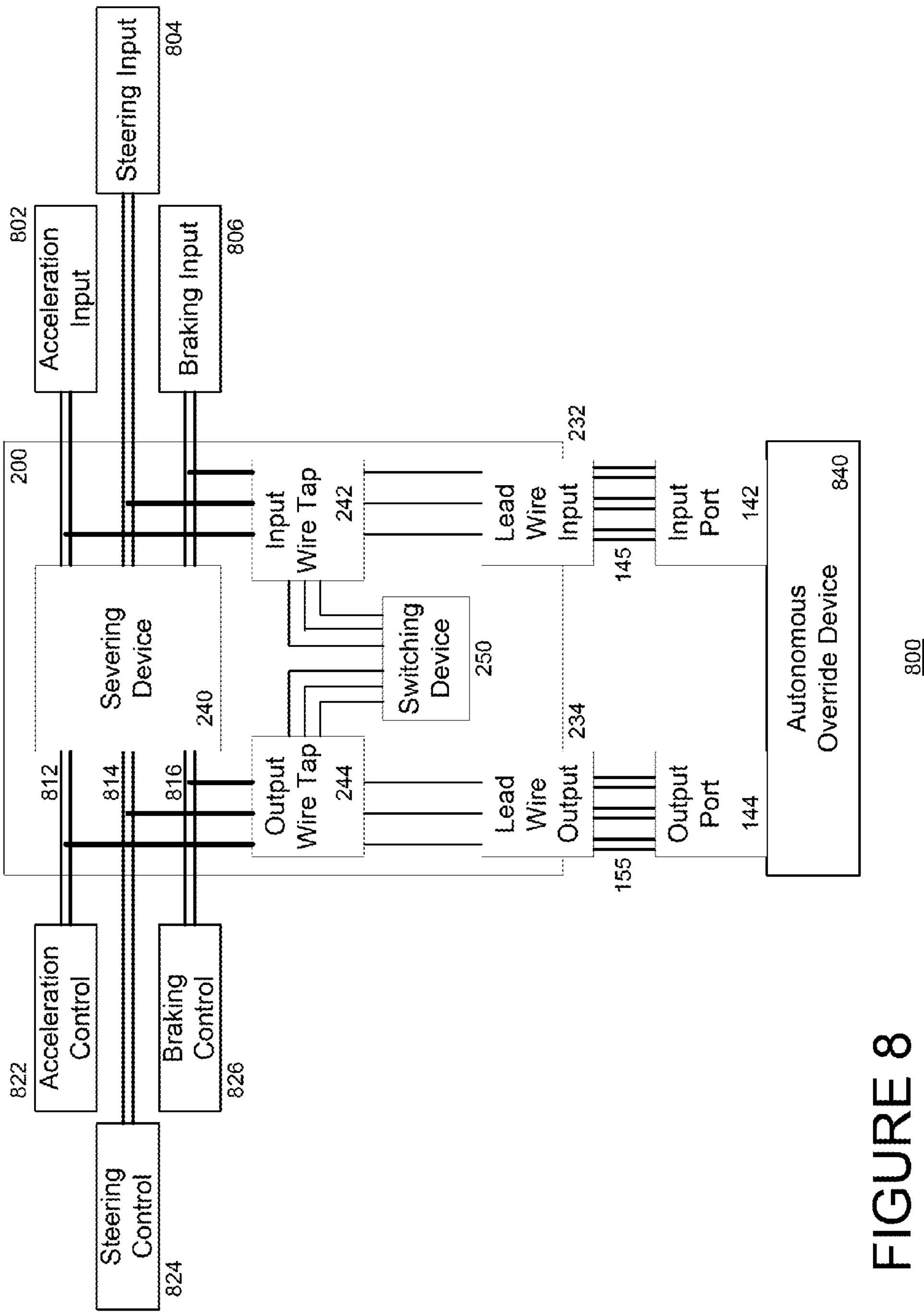

Acceleration Input
802
Steering Input
804
Braking Input
806
200
232
Input Wire Tap
242
Lead Wire Input
145
Input Port
142
Severing Device
240
Switching Device
250
234
812
814
816
Output Wire Tap
244
Lead Wire Output
155
Output Port
144
Autonomous Override Device
840
Acceleration Control
822
Braking Control
826
Steering Control
824
800

FIGURE 8

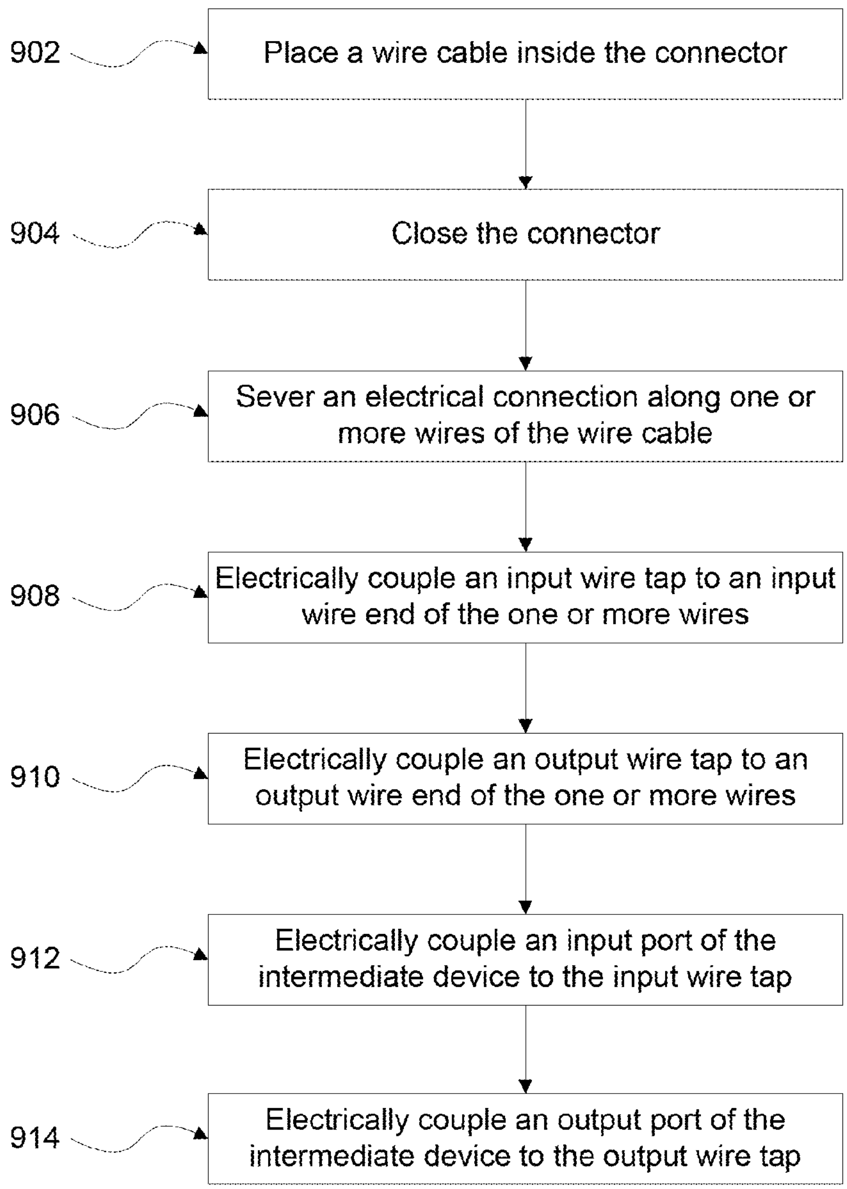

902
Place a wire cable inside the connector
904
Close the connector
906
Sever an electrical connection along one or more wires of the wire cable
908
Electrically couple an input wire tap to an input wire end of the one or more wires
910
Electrically couple an output wire tap to an output wire end of the one or more wires
912
Electrically couple an input port of the intermediate device to the input wire tap
914
Electrically couple an output port of the intermediate device to the output wire tap

FIGURE 9

900

METHOD FOR PLACING AN INTERMEDIATE DEVICE IN SERIES WITH AT LEAST ONE WIRE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a divisional of U.S. patent application Ser. No. 13/440,124, filed on Apr. 5, 2012, now U.S. Pat. No. 8,585,430, the disclosure of which is incorporated herein by reference.

BACKGROUND

Signal patching allows for placing a device in series with a wire. This allows the patched device to override and patch signals into the wire, thereby controlling other objects or devices connected to the wire.

In order to patch a device into a preexisting wire, one must cut the wire, strip both sides of the cut wire, crimp pins onto each side of the cut wire, and connect the device to the pins. This process is manual, laborious, and time consuming. Further, points where the wire is cut and subsequently reconnected may constitute single points of failure for the whole system. Moreover, often times every wire in a bundle of wires or in a multi-wire cable will have to be cut just to patch into one or two of the wires.

SUMMARY

One aspect of the disclosure provides a connector for placing a device in connection with a first device and a second device. The first device and second device may be coupled via at least one wire. The connector may comprise a housing comprising an upper housing portion and a lower housing portion. Accordingly, the housing may be sized to encase a portion of the wire. The connector may also comprise a cavity between the upper housing portion and the lower housing portion. The connector may also comprise a severing device affixed to an interior wall of the housing and occupying a space within the cavity. The severing device may be adapted to sever the wire, thereby producing a first wire end and a second wire end. The connector may also comprise a first wire tap affixed to an interior wall of the housing and occupying a space within the cavity. The first wire tap may be adapted to be electrically coupled to the first wire end. The connector may also comprise a second wire tap affixed to an interior wall of the housing and occupying a space within the cavity. The second wire tap may be adapted to be electrically coupled to the second wire end. The first wire tap and the second wire tap may be adapted to be coupled to a third device.

According to one aspect, the connector may also comprise a switching device electrically coupled between the first wire tap and the second wire tap. The switching device may have a first state in which an electrical connection between the first and second wire taps is completed, and a second state in which the electrical connection between the first and second wire taps is open.

Another aspect of the disclosure provides a system, comprising a transmitting device configured for transmitting electrical signals, a receiving device configured for receiving electrical signals, and at least one wire for transmitting electrical signals between the transmitting device and the receiving device. The system may also comprise an intermediate device having an input port and an output port. The system may also comprise a connector for placing the intermediate device in connection with the transmitting device and the receiving device. The connector may comprise a housing comprising an upper housing portion and a lower housing portion. Accordingly, the housing may be sized to encase a portion of the wire. The connector may also comprise a cavity between the upper housing portion and the lower housing portion, a first lead wire port providing a first opening between an exterior surface of the upper housing portion and the cavity, and a second lead wire port providing a second opening between an exterior surface of the upper housing portion and the cavity. The first lead wire port may be adapted to receive a first lead wire of the intermediate device, and the second lead wire port may be adapted to receive a second lead wire of the intermediate device. The connector may also comprise a severing device affixed to an interior wall of the housing and occupying a space within the cavity. The severing device may be adapted to sever the wire, thereby producing a first wire end and a second wire end. The connector may also comprise a first wire tap affixed to an interior wall of the housing and occupying a space within the cavity. The first wire tap may be adapted to be electrically coupled to the first wire end. The connector may also comprise a second wire tap affixed to an interior wall of the housing and occupying a space within the cavity. The second wire tap may be adapted to be electrically coupled to the second wire end.

A further aspect of the disclosure provides a method for placing an intermediate device in series with at least one wire. The method may comprise placing the wire inside a connector, the connector comprising a housing, a cavity within the housing, a severing device attached to the housing within the cavity, a first wire tap, and a second wire tap. The method may also comprise closing the connector, encasing a portion of the wire within the cavity. Upon closing the connector, the connector may sever the wire, thereby producing a first wire end and second wire end, electrically couple the first wire tap to the first wire end, and electrically couple the second wire tap to the second wire end. The method may also comprise electrically coupling an input port of the intermediate device to the input wire tap, and electrically coupling an output port of the intermediate device to the output wire tap.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a functional diagram of a system in accordance with aspects of the disclosure.

FIG. **2** is a perspective view of an example connector in a first configuration, along with an exploded top-down view of a portion of the connector, in accordance with aspects of the disclosure.

FIG. **3** is a perspective view of the example connector of FIG. **2** in a second configuration in accordance with aspects of the disclosure.

FIG. **4** is a partial cross sectional view of the connector of FIG. **2**.

FIG. **5** is a partial cross sectional view of the connector of FIG. **3**.

FIG. **6** is another partial cross sectional view of the connector of FIG. **3**.

FIG. **7** is a functional diagram of a system in accordance with aspects of the disclosure.

FIG. **8** is another functional diagram of a system in accordance with aspects of the disclosure.

FIG. **9** is a flow diagram in accordance with aspects of the disclosure.

DETAILED DESCRIPTION

Aspects, features and advantages of the disclosure will be appreciated when considered with reference to the following description of embodiments and accompanying figures. The same reference numbers in different drawings may identify the same or similar elements. Furthermore, the following description is not limiting; the scope of the present disclosure is defined by the appended claims and equivalents.

FIG. **1** is a functional diagram of a system **100** in accordance with aspects of the disclosure. The system **100** may include a first device **110** and a second device **120**, such as a transmitting device **110** and a receiving device **120** in an autonomous vehicle. For example, the transmitting device **110** may be a user input associated with a system of the autonomous vehicle, such as an accelerator pedal for controlling the acceleration system of the vehicle, a braking pedal for controlling the braking system of the vehicle, a steering wheel for controlling the steering system of the vehicle, etc. The receiving device **120** may be a control associated with the same system of the autonomous vehicle as the transmitting device **110**, such an acceleration control, a deceleration control, or a steering control.

The transmitting device may transmit one or more signals to the receiving device **120** via one or more wires, such as a wire cable **125**. The wire cable **125** may include any number of discrete wires **130**. For example, the wire cable **125** may be a single wire, a multi-wire ribbon cable including 20 or more discrete wires, a fiber-optic cable, or any other type of wire capable of carrying a signal.

The system **100** may also include an intermediate device **140**, such as an autonomous override device for controlling an autonomous vehicle. The intermediate device **140** may be coupled to each of the transmitting device **110** and the receiving device **120** through a connector **200**. The intermediate device **140** may include an input port **142** for receiving signals sent by the transmitting device **110**, and an output port **144** for sending signals to the receiving device **120**. For example, the autonomous override device **140** may receive an input signal from the accelerator pedal, braking pedal, or steering wheel of the vehicle, and may transmit an output signal (e.g., the received signal, a modified version of the received signal, a newly generated signal) to the accelerator, brake, or steering column of the vehicle. According to one aspect, the input port **142** and output port **144** may be a single port, for example, coupled to the connector via a coaxial cable.

As described herein, the connector **200** may splice the wire cable **125** between the transmitting device **110** and the receiving device **120**, form connections to each of a first wire end **128** and a second wire end **129** of the spliced wire cable **125**, and couple the spliced wire ends **128**/**129** to an input port **142** and output port **144**, respectively, of the intermediate device **140**. In one example, the connector **200** may form a connection to the first wire end **128** of the wire cable **125** and relay signals transmitted from the transmitting device **110** via the first wire end **128** to the input port **142** of the intermediate device **140** via an input lead wire **145**. In another example, the connector **200** may form a connection to the second wire end **129** of the wire cable and relay signals transmitted from the intermediate device **140** via an output lead wire **155** to the receiving device **120** via the second wire end **129**. Using the connector **200** to couple the intermediate device **140** to the transmitting and receiving devices **110**/**120** may increase the efficiency and streamline the process of patching a device in series with a preexisting wire considerably reducing the time and labor normally involved.

As shown in FIGS. **2** and **3**, the connector **200** may include a housing **201**, which may be made of a firm, resiliently flexible, plastic insulating material, such as polypropylene. The housing **201** may include an upper housing **202**, and a lower housing **204**. In the example of FIGS. **2** and **3**, the upper housing **202** and lower housing **204** may be connected by hinges **206** along a back wall **210** of the connector **200**. In other examples, the upper housing **202** and lower housing **204** may be connected by a post, cup, or other guiding feature. The upper housing **202** and lower housing **204** may touch along a portion of each of the back wall **210**, front wall **218**, input sidewall **212**, and output sidewall **214**, at a border **203**. As described in greater detail below, portions of the upper housing **202** and lower housing **204** may be separated on the interior of the connector **200** by hollowing out a portion of the interior of the connector **200** (such as a cavity **208** shown below in connection to FIG. **3**).

The connector **200** may also include various holes and/or apertures bridging the exterior and the interior of the connector **200**. For example, the connector **200** may include a transmitting wire port **222** and a receiving wire port **224**, enabling the wire **125** to access the interior cavity **208** of the connector. As a further example, the connector **200** may include a lead wire input port **232** and a lead wire output port **234** adapted to receive lead wires **145**, **155** (e.g., coupled to the input port **142** and output port **144** of the intermediate device).

The transmitting and receiving wire ports **224** may each provide an opening between the exterior and the interior of the connector **200** (e.g., on the input sidewall **212** and the output sidewall **214**, respectively). In this regard, a wire cable **125** may be inserted through the transmitting wire port **222**, pass through the hollowed out portion of the interior of the connector **200**, and exit out the receiving wire port **224**. In some examples, the dimensions of the transmitting and receiving wire ports **222** and **224** may be slightly greater than the dimensions of the wire cable (e.g., the wire cable may fit through the port with little or no room to spare). Where the wire cable fits into the wire ports with some room to spare, all or some portion of the excess room may be filled with a sealant material, such as a grease or silicone gel, to seal out moisture from the interior of the connector **200** and to protect the components in the interior of the connector **200** against oxidation.

The lead wire input port **232** and output port **234** may provide one or more openings between the upper wall **216** and the interior of the connector **200**. An exploded top-down view of an upper surface **260** of lead wire input port **232**, which may be identical in appearance to the lead wire output port **234**, is shown in FIG. **2**. The upper surface **260** of the lead wire input port **232** may include one or more lead wire holes **233** capable of receiving a lead wire (e.g., the lead wire **145**). For example, where the lead wire **145** comprises multiple wires (e.g., in a bundle), multiple lead wire holes **233** may be present and may each receive an individual wire of the bundle. In one example, the lead wire holes **233** may be arranged in a staggered, or zig-zag, pattern, such as in the arrangement in FIG. **2**. In another example, the lead wire holes **233** may be aligned in a single row, or in any other configuration.

In the example where the upper housing **202** and lower housing **204** are connected by hinges **206**, the connector **200** may be opened and closed along the rotational axis of the hinges **206**. In other examples, where the upper housing **202** and lower housing **204** of the connector **200** are connected by a post, cup, or other guiding feature, the connector **200** may be opened and closed along the axis of the guiding feature. FIG. **2** is an example of the connector **200** while closed, showing portions of the exterior of the connector **200**. FIG. **3** is an example of the connector **200** while open, showing portions of both the interior and exterior of the connector **200**. As shown in the example of FIG. **3**, while the connector is open, the upper housing **202** and lower housing **204** may touch only along the back wall **210**, making the interior of the connector

200 accessible through the front wall 218, input sidewall 212, and output sidewall 214. In other examples, the upper housing 202 and lower housing 204 may separate entirely while the connector 200 is open, making the interior of the connector 200 accessible even through the back wall 210.

Turning to the interior of the connector 200 in FIG. 3, a portion of the housing 201 may be hollowed out to form the cavity 208 within the interior. The cavity 208 may extend from the transmitting wire port 222 to the receiving wire port 224. The cavity 208 may be of uniform width 208W and of uniform height 208H. In the example of FIG. 3, the cavity 208 is shaped to fit a planar multi-wire cable, such as the wire cable 125 of FIG. 1. In one example, the width 208W and height 208H may be slightly greater than the width and height of the wire cable (e.g., the wire cable fits into the cavity 208 with little or no room to spare). Where the wire cable fits into the cavity 208 with some room to spare, a portion of excess room may be filled with a sealant material, such as the sealant material described above.

The connector 200 may also include various components affixed within the interior of the housing 201. For example, the connector 200 may include a severing device 240, an input wire tap 242, an output wire tap 244, and a switching device 250 (encased within the upper housing 102).

The severing device 240 may be useful for interrupting the electrical connection along a wire cable placed inside the connector 200. The severing device 240 may be a blade, scissors, wire cutter, shear, heating implement, clamp, or other implement capable of interrupting the electrical conductivity along the wire cable 125. According to some aspects, the severing device 240 may include recesses along a cutting edge the severing device 240. The recesses may extend from the cutting edge of the severing device 240 towards the upper housing 202 of the connector 200, such that a portion of the cutting edge is removed. Moreover, the recesses may be selectively positioned so based on a positioning of wires to be severed and wires to be kept intact.

The input wire tap 242 and output wire tap 244 may each include a nonconductive post 243 and one or more pins 247, 249 affixed to the nonconductive post 243. The input wire tap 242 and output wire tap 244 may each be useful for tapping into a conductive core of the wire cable 125 placed inside the connector 200. For example, the pins 247/249 may be made from tin plated brass or another conductive metal. In one example, the tip of each pin may be a single point. In another example, the tip of each pin may include multiple points in a fork-shaped arrangement. Each of the points may be sharpened in order to effectively pierce through the insulation of the wire and form a contact with the wire's conductive core. The nonconductive post 243 may be made from a firm, resiliently flexible, plastic insulating material, such as polypropylene, to reinforce the pins 247, 249 and keep the pins 247, 249 properly aligned. In another example, the pins 247, 249 may be affixed directly to the upper housing. In such an example, the input wire tap 242 may consist only of the pins 247 and no additional material.

The switching device 250 may include one or more switches for controlling an electrical connection between the pins 247, 249 of the input wire tap 242 and the output wire tap 244. The switching device 250 is described in greater detail below with reference to FIG. 5.

FIG. 4 is a cross-sectional view, along reference line 270 (shown in FIG. 3), of the connector 200 in the open configuration. Because FIG. 4 is a cross-sectional view, only the lower housing 202 of the connector and one wire 130 of a wire cable 125 are shown, as the upper housing of the connector 200 and the other wires of the wire cable 125 are not in line with the plane of reference line 270. The wire 130 may be positioned on top of the lower housing 204 while the connector 200 is open as a preliminary step to attaching the connector 200 across the wire 130. The wire 130 may include a conductive core 139 encased in insulation 137. The insulation 137 may enclose the conductive core 139 on all sides. For example, the insulation 137 may separate the conductive core 139 from the conductive core of each of the other wires in the wire cable 125.

In the example of FIG. 5, the connector 200 is closed. The severing device 240, which may be affixed to the upper housing 202, occupies a portion of the cavity 208 between the input sidewall 212 and the output sidewall 214. As the severing device 240 is lowered into the cavity (upon closing the connector 200), the severing device 240 cuts through the wire 130, interrupting the electrical connection between a first wire end 128 and a second wire end 129 of the severed wire 130. In an example where a sealant is used to fill the remaining space of the cavity 208, as described above, the sealant may also be used to insulate the severed ends of the wire 130, to prevent the severed ends from twisting, or to provide relief against strain.

In the example of FIG. 5, the severing device 240 may sever each of the wires in the wire cable 125. Alternatively, where the severing device 240 includes one or more recesses, the severing device 240 may sever only a preselected subset of wires in the wire cable 125. For example, when the connector 200 is closed, the notches/grooves may align with wires to be kept intact, and the remaining wires may be severed.

The input and output wire taps 242 and 244 may be affixed to the interior wall of the upper housing 202 opposite the corresponding input and output ports 232 and 234. For example, the input wire tap 242 may occupy a portion of the cavity 208 containing the first wire end 128 of the severed wire 130, and the output wire tap 244 may occupy a portion of the cavity 208 containing the second wire end 129 of the severed wire 130.

Each of the wire taps 242 and 244 may include one or more pins. Because FIG. 5 is a cross-sectional view, only one input pin 247 and one output pin 249 are shown, as the other pins are not in line with the plane of reference line 280. The input pin 247 and output pin 249 are nonetheless representative of the other pins included in the input and output wire taps 242 and 244. As mentioned above, the tip of each pin may be sharpened in order to effectively pierce through the insulation 137 of the wire 130. When the connector 200 is closed, the pins 247/249 may pierce through the insulation 137 and electrically contact the conductive core 139 of the wire 130. For example, the input pin 247 may contact the conductive core 139 of the first wire end 128, and the output pin 249 may contact the conductive core of the second wire end 129. By contacting the conductive core 139 of the wire 130, a signal sent through the wire 130 may be intercepted by the contacting pin.

The switching device 250 may be encased in the upper housing 202 of the connector, between the input and output wire taps 242 and 244, and may electrically couple an input pin 247 of the input wire tap 242 to a corresponding output pin 249 of the output wire tap 244. For each pair of corresponding pins 247/249 electrically coupled by the switching device 250, the switching device may include a switch 255 coupled therebetween. The switch 255 may close or open a connection between the corresponding pins 247/249, establishing an open circuit or closed circuit, respectively. For example, when the switch 255 is closed, the switch 255 may establish a closed circuit between the pin 247 of the first wire tap 242 and a corresponding output pin 249 of the second wire tap

244. Thus, once the signal from the wire 130 is patched into and intercepted by the input pin 247, the signal may be relayed directly from the input pin 247 to the corresponding output pin 249 via the switching device 250, without traveling out of the connector 200. Conversely, when the switch 255 is open, the switch 255 may break the circuit between the corresponding pins 247/249. Thus, the signal may no longer be relayed directly from the input pin 247 to the corresponding output pin 249 via the switching device 250.

The switching device 250 may include a single switch 255 for establishing an open circuit or closed circuit between each pair of corresponding pins 247/249. In another example, the switching device 250 may include a separate switch 255 for each pair of corresponding pins 247/249. For example, a first switch coupled between a first pair of pins 247/249 may be open, while a second switch coupled between a second pair of pins 247/249 may be closed. In another example, the switching device 250 may include one or more switches 255 which may be coupled between any one of the input pins 247 to any one of the output pins 249, effectively crossing signals between the corresponding pairs of pins 247/249. In other words, the configuration of switches 255 in the switching device may include any possible permutation of electrical connections between the input and output pins 247/249.

FIG. 6 illustrates a cross-sectional view of the connector 200 along reference line 290 (shown in FIG. 2). As shown, several discrete wires 130 included in the wire cable 125 may be positioned in the cavity 208 in relation to several input pins 247 included in the input wire tap 242. The input pins 247 may be arranged in a staggered pattern in order to align properly with the staggered arrangement of the lead wire holes 233. Therefore, only every alternating pin included in the input wire tap 242 is shown in FIG. 6, as the other pins are not in line with the plane of reference line 290. The input pins 247 may each pierce the insulation 137 of a discrete wire 130, contacting the conductive core 139 of the wire 130. As described above, by contacting the respective conductive cores 137 of the wires 130, signals sent through the wires 130 may be intercepted by the pins 247.

Each of the input pins 247 may extend from the cavity 208, through the nonconductive part 243, to the upper wall 216 of the connector 200 via an input lead wire hole 233. According to some aspects, each input pin 247 may extend beyond the upper wall 216 of the connector 200, as illustrated in FIG. 6. Alternatively, each input pin 247 may be recessed within the lead wire hole 233. The different configurations may accommodate different types of connectors for coupling the intermediate device. In either of these examples, when the lead wire for the intermediate device is coupled to the pin 247, a signal sent through a wire 130 and intercepted by the input pin 247 may be relayed through the pin 247 to the lead wire.

In the above example, the input wire tap 242 may include an input pin 247 for each of the wires 130 placed in the connector 200. In another example, the input wire tap 242 may include input pins 247 only for a preselected subset of the wires 130. This may be accomplished by removing pins 247 from the input wire tap 242 in locations where it is not desired that a wire be patched into, such as a wire that was not severed by the severing device 240. In this case, when the connector 200 is closed, the input pins 247 may align with and pierce the severed wires 130, while the rest of the wires 130 remain intact.

Although the output wire tap 244 and the output pins 249 are not shown, they may be arranged similarly to the input wire tap 242 and input pins 247.

FIG. 7 is a functional diagram of the system 100 depicted in FIG. 1. As described above, the wire cable 125 provides a direct connection for transmitting electrical signals from the transmitting device 110 to the receiving device 120. The severing device 240 of the connector 200 may interrupt this direct connection, producing a first wire end 128 and a second wire end 129 of the severed wire cable 125. Input and output wire taps 242 and 244 may tap into the input and output wire ends 128 and 129, respectively. Thus, a signal sent across the first wire end 128 may be intercepted by the input wire tap 242, while a signal sent to the output wire tap 244 may be patched into the second wire end 129.

According to one example, a signal sent by the transmitting device 110 along the first wire end 128 may be intercepted by the input wire tap 242 and relayed to the input lead wire 145, which is coupled to the input wire tap at the lead wire input port 232. From the input lead wire 145, the signal may be further relayed to the input port 142 of the intermediate device 140, and finally to the intermediate device 140. Thus, the intermediate device 140 may receive a signal transmitted by the transmitting device 110.

According to another example, a signal transmitted by the intermediate device 140 to the output lead wire 155 via the output port 144 may be relayed to the output wire tap 244, into which the output lead wire 155 is plugged at the lead wire output port 234. From the output wire tap 244, the signal may be further patched into the second wire end 129 and sent to the receiving device 120. Thus, the receiving device 120 may receive a signal transmitted by the intermediate device 140.

When connected to the transmitting device 110 and to the receiving device 120, the intermediate device 140 may intercept, modify, override, and/or relay the signals sent between the two devices. The intermediate device 140 may also generate its own signals to be transmitted to the receiving device 120.

In one example, the switching device 250 may control whether the intermediate device 140 receives signals from the transmitting device 110. When the switch 255 included in the switching device 250 is open, an open circuit may be established between the input and output wire taps 242 and 244. The open circuit across the switching device may have no effect on the connection between the wire taps 242 and 244 and the intermediate device 140. When the switch 255 is closed, a closed circuit may be established between the input and output wire taps 242 and 244. This may effectively short out the intermediate device 140, as any electrical signal relayed to the input wire tap 242 may be passed directly to the output wire tap 244 via the switching device 250. Furthermore, closing the switch 255 may reestablish the direct electrical connection between the transmitting device 110 and the receiving device 120, albeit through the switching device 250 instead of through the wire cable 125.

When the switch 255 is closed and the intermediate device 140 is effectively shorted out, the intermediate device 140 may still monitor signals sent between the transmitting device 110 and the receiving device 120. However, the intermediate device may no longer be capable of intercepting, overriding, or otherwise intervening with signals sent between the two devices, as the signals may be relayed through the switching device 250 without passing through the intermediate device 140.

As described in the general example above, the connector 200 may be used to connect devices capable of receiving and/or transmitting electrical signals. According to one specific example, the connector may be used to connect an autonomous override device, capable of maneuvering a vehicle autonomously or semi-autonomously, with the inputs and controls for various systems of the vehicle. For example, FIG. 8 is a functional block diagram of an autonomous vehicle system **800**. The connector **200** is connected to several inputs and controls of a vehicle, such as an acceleration input **802**, steering input **804**, and braking input **806**. The acceleration input **802** may be a user input associated with the acceleration system of the vehicle, and may be coupled to an acceleration control **822** (e.g., a control system associated with accelerating the vehicle) via an acceleration wire **812**. The steering input **804** may be a user input associated with the steering system of the vehicle, and may be coupled to a steering control **824** via a steering wire **814**. The braking input **806** may be coupled to a braking control **826** via a braking wire **816**.

The connector **200**, when attached across the wires **812-816**, may interrupt the direct communication between the vehicle inputs **802-806** and their corresponding controls **822-826** using the severing device **240**. The input and output wire taps **242** and **244** may patch into the acceleration, steering, and braking wires **812-816**. Because the input wire tap **242** may be communicatively coupled to the lead wire input **232**, the signals sent from the inputs **802-806** may be relayed to an autonomous override device **840** through the lead wire input port **232**. Similarly, signals sent from the autonomous override device **840** (which may be the same as the input signals, modified versions of the input signals, newly generated signals, etc.) may be transmitted to the vehicle controls **822-826** through the lead wire output port **234**.

In one example, a steering input **806** sent by a driver using the steering wheel of an autonomous vehicle may be intercepted by the autonomous override device **840**. The intercepted steering signal may be modified by the autonomous driving system **840**. For instance, if the autonomous vehicle detects a slight bend in the road ahead, the autonomous override device **840** may modify a steering signal corresponding to a sharp turn into a signal corresponding to a slight turn to keep the autonomous vehicle on a road. Alternatively, the intercepted steering signal may be replaced by a newly generated signal originating from the autonomous override device **840**. For instance, the autonomous override device may maneuver the autonomous vehicle without any input from the driver, regardless of whether or not the driver turns the steering wheel **806**.

The above example described a steering signal intercepted and subsequently modified or replaced by the autonomous override system **840**. In other examples, the autonomous override system **840** may intercept, modify, and/or replace signals associated with other controls of the autonomous vehicle, such as the acceleration, braking, etc. Moreover, the inputs and controls coupled to the override device via the connector are not limited to those associated with acceleration, steering, and braking systems. The inputs and controls may also be associated with systems for controlling headlights (e.g., controlling high and low headlight beams), turn signals, brake signals, door locks, a car horn, audio/video functions, or other features of an autonomous vehicle.

The example systems described above may be constructed using the method described herein. It should be understood that the following operations do not have to be performed in the precise order described below. Rather, various operations can be handled in a different order, or simultaneously. Moreover, operations may be added or omitted.

FIG. **9** illustrates an example flow chart **900** in accordance with some of the aspects described above. In block **902**, the wire cable **125** may be placed inside the connector **200**. For example, the wire cable may be placed in the cavity **208** of the connector **200**. One end of the wire cable **125** may extend out the transmitting wire port **222** on the input sidewall **212** of the connector **200**, and the opposite end of the wire cable **125** may extend out the receiving wire port **224** on the output sidewall **214** of the connector **200**.

The wire cable **125** may fit through the transmitting and receiving wire ports **222** and **224**, and through the cavity **208**. Excess room between the wire and the ports may optionally be filled with a nonconductive sealant material to seal out moisture from the interior of the connector **200** and to protect the components in the interior of the connector **200** against oxidation.

In block **904**, the connector **200** may be closed around the wire cable **125**. For example, the upper housing **202** of connector may be clamped together with the lower housing **204**. Closing the connector **200** may also involve locking the connector **200** to ensure that the connector **200** remains closed. In one example, a latch on the front wall of the housing **201** of the connector **200** may be fastened to ensure that the upper and lower housings **202** and **204** do not separate. In another example, the upper and lower housings **202** and **204** may be fastened together with clips. In another example, guiding features, such as the posts or cups described above, may hold the upper and lower housings **202** and **204** together.

In block **906**, the severing device **240** may sever an electrical connection along one or more wires of the wire cable **125**. For example, upon closing the connector **200**, the severing device **240** may cut each of the one or more wires, producing a first wire end **128** and a second wire end **129** for each of the one or more wires.

In block **908**, the input wire tap **242** may tap into the first wire end **128** of the one or more wires. In one example, an input pin **247** included in the input wire tap **242** may displace the insulation **137** and contact the conductive core **139** of the first wire end **128**. In another example, tapping the input pin **247** of the input wire tap **242** into the one or more wires may involve crimping the input pin **247** to the first wire end **128** of the one or more wires.

In block **910**, the output wire tap **244** may tap into the second wire end **129** of the one or more wires. In one example, an output pin **249** included in the output wire tap **244** may displace the insulation **137** and contact the conductive core **139** of the second wire end **128**. In another example, tapping the output pin **249** into the one or more wires may involve crimping the output pin **249** to the second wire end **129** of the one or more wires.

In block **912**, the input port **142** of the intermediate device **140** may be electrically coupled to the lead wire input port **232** of the connector **200** via the input lead **145**. In one example, coupling the input port **142** to the lead wire input port **234** may involve crimping the input lead wires **145** to one or more input pins **247**. In another example, the input lead wire **145** may be coupled directly to the input pins **247** without crimping. In yet another example, where the input pins **247** are recessed within the lead wire input port **232** and do not extend beyond the upper wall **210** of the connector **200**, the input lead wire **145** may be coupled to the input pins **247** simply my plugging the input lead wire **145** into the one or more lead wire holes **233** of the lead wire input port **232**.

In block **914**, the output port **144** may be electrically coupled to the lead wire output port **234** of the connector **200** via the output lead wire **155**. In one example, coupling the output port **144** to the lead wire output port **234** may involve crimping the output lead wire **155** to one or more output pins **249**. In another example, the output lead wire **155** may be coupled directly to the output pins **249** without crimping. In yet another example, where the output pins **249** are recessed within the lead wire output port **234** and do not extend beyond the upper wall **216** of the connector **200**, the output lead wire

155 may be coupled to the output pins simply by plugging the output lead wire 155 into the one or more lead wire holes 233 of the lead wire output port 234.

In the examples described above, the connector 200 receives, severs, and patches into a single wire cable 125. In other examples of the disclosure, the connector 200 may receive, sever, and patch into a bundle of separate wires. The separate wires may be of different shapes and lengths, so long as each wire is long enough to extend out both the input sidewall 212 and the output sidewall 214 when placed inside the connector 200. Placing separate wires into the connector 200 may allow a user of the connector to patch into several devices, each connected by separate wires, with a single motion of closing the connector 200. In this case, the intermediate device 140 may receive and transmit signals between multiple transmitting and receiving devices 110 and 120.

Also in the examples described above, the connector 200 connects to only one intermediate device via lead wires 144/155 connected to a lead wire input port 232 and a lead wire output port 234 of the connector. In other examples, separate wires may be connected to each of the holes 233 of the lead wire input and output ports. Connecting separate wires to the holes 233 of the lead wire input and output ports 232 and 234 may allow a user of the connector to connect several intermediate devices 140 to the connector (i.e., one intermediate device 140 for each pair of lead wires connected to pins 243 in a pair of corresponding holes 233). In this case, each of the separate intermediate devices may receive and transmit signals associated with a separate wire running between the transmitting device 110 and the receiving device 120.

The above-described technology may be advantageous in that it enables an intervening device to intercept signals between devices without the difficulty of manually cutting wire ends between the devices, crimping pins onto each side of the cut wire, and connecting the intervening device to the pins. Thus, intervening devices may be coupled in series with other devices with greater speed and reduced cost. Moreover, the intervening devices may be coupled to wires that are difficult or impossible to access, such as wires in a narrow space where it may be difficult or impossible to manually strip and crimp the wires. Moreover, because the connector may include a switching device, the direct electrical connection of the severed wire may be restored without manually disconnecting the intervening device and reconnecting the cut wire. Thus, for example, when the connector is implemented in an autonomous vehicle as described in FIG. 8, the driver may efficiently switch in and out of an autonomous driving mode.

As these and other variations and combinations of the features discussed above can be utilized without departing from the systems and methods as defined by the claims, the foregoing description of exemplary implementations should be taken by way of illustration rather than by way of limitation of the disclosure as defined by the claims. It will also be understood that the provision of examples (as well as clauses phrased as "such as," "e.g.", "including" and the like) should not be interpreted as limiting the disclosure to the specific examples; rather, the examples are intended to illustrate only some of many possible aspects.

The invention claimed is:

1. A method for placing an intermediate device in series with at least one wire, the method comprising:
 - placing the at least one wire inside a connector, the connector comprising a housing, a cavity within the housing, a severing device attached to the housing within the cavity, a first wire tap, and a second wire tap;
 - closing the connector, encasing a portion of the at least one wire within the cavity, wherein upon closing the connector, the connector:
 - severs the wire, thereby producing a first wire end and a second wire end;
 - electrically couples the first wire tap to the first wire end; and
 - electrically couples the second wire tap to the second wire end;
 - electrically coupling an input port of the intermediate device to an input wire tap; and
 - electrically coupling an output port of the intermediate device to an output wire tap.

2. The method of claim 1, the method further comprising intercepting a signal from the first wire end at the intermediate device.

3. The method of claim 2, the method further comprising modifying the intercepted signal.

4. The method of claim 1, the method further comprising transmitting a signal from the intermediate device to the second wire end.

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